Service-oriented Cost Allocation for Business Intelligence

(Working Paper)

27.04.2014

Authors

M.Sc. Raphael Grytz

Jun.-Prof. Dr. Artus Krohn-Grimberghe

Authors' addresses for publication

Analytic Information Systems and Business Intelligence

Universität Paderborn

Warburger Straße 10

33098 Paderborn

Germany

grytz@aisbi.de

artus@aisbi.de

Service-oriented Cost Allocation for Business Intelligence

Abstract

Due to increasing competition and cost pressure, many companies require a data basis for the preparation and execution of business decisions. Business Intelligence (BI) supports this task and has thus gained in importance for many companies in recent years. The process of data provision generates considerable expenses in a predominantly heterogeneous IT company system landscape. This creates a non-negligible cost pool, which requires justification to management, particularly during difficult economic times. This situation is aggravated by the fact that this cost pool is not precisely quantifiable in most cases.

To justify BI projects or to come closer to a financial evaluation of the success of a BI project, the BI cost pool has to be quantified and designed accountable to allow a more exact allocation of costs in a fair way. BI projects, in particular, are different from IT projects. They are IT based but due to constantly changing requirements and a more heterogeneous and continuously changing BI architecture, the arising complexity is to be evaluated differently than in IT projects. Therefore, we consider it necessary to offer a cost evaluation of a single BI application (running or planned). The concept presented in this paper is developed for BI in-house departments, which could also be adapted for companies hosting BI applications as a service. The underlying difficulty is to allocate project and operation costs from the BI cost pool to a single BI application in order to charge them to beneficiaries in an economic manner.

To tackle this problem, we propose a service-oriented cost allocation that offers a calculation schema for BI applications based on defined services and realizes a cost transfer to beneficiaries. Because it is not necessarily possible to adapt IT methods for BI for this case, a comparison between the IT and BI domain is made. Thereafter the current state in this field of research is presented. As a contribution a general process model is developed. The key steps are described and are implemented using examples.

Keywords

Controlling, Service-oriented Cost Allocation, Internal Cost Allocation, Business Intelligence, Decision Support Systems, Cost Evaluation

Serviceorientierte Leistungsverrechnung für Business Intelligence

Abstract

Der zunehmende Wettbewerbs- und Kostendruck in vielen Unternehmen erfordert eine Datengrundlage zur Vorbereitung und Durchführung von Unternehmensentscheidungen. Business Intelligence (BI) unterstützt diese Aufgabe und hat in den letzten Jahren in vielen Unternehmen zunehmend an Bedeutung gewonnen. Der Prozess zur Datenbereitstellung erzeugt in einer heterogen geprägten IT-Systemlandschaft einen erheblichen Aufwand. Dadurch entsteht ein nicht zu vernachlässigender Kostenblock, der besonders in wirtschaftlich schweren Zeiten gegenüber dem Management einer Rechtfertigung bedarf.

Um BI-Projekte zu begründen bzw. einer Kostenbewertung von BI-Projekten näher zu kommen, muss der BI-Kostenblock quantifiziert und verrechenbar gestaltet sein damit eine genaue

und somit verursachungsgerechte Verrechnung möglich wird. BI-Projekte unterscheiden sich insbesondere von IT-Projekten. Sie sind IT-basiert, jedoch ist bedingt durch die sich kontinuierlich verändernden Anforderungen, eine heterogene und sich laufend verändernde BI-Architektur die dadurch entstehende Komplexität anders zu bewerten als bei IT-Projekten. Daher betrachten wir die Kostenbewertung einer einzelnen BI-Applikation (im Betrieb oder geplant) als notwendig. Das in diesem Beitrag präsentierte Konzept wird für firmeninterne BI-Abteilungen entwickelt, welches jedoch auch für Unternehmen angepasst werden kann, die BI-Applikationen „as a Service“ bereitstellen. Die grundlegende Schwierigkeit besteht darin Projekt- und Betriebskosten aus dem BI-Kostenblock einer einzelnen BI-Applikation zu zuweisen und dem Leistungsempfänger zu verrechnen.

Zur Lösung dieser Problematik wird in diesem Beitrag eine serviceorientierte Leistungsverrechnung konzipiert, die eine Verrechnung der anfallenden Kosten an Leistungsempfänger realisiert. Da IT-Methoden für diesen Fall nicht ohne weiteres auf BI übertragen werden können, ist für die Evaluierung eine Abgrenzung zu BI notwendig. Anschließend wird ein Überblick von bestehenden Methoden in diesem Forschungsbereich gegeben. Als Ergebnis dieses Beitrags wird ein allgemeines Vorgehensmodell entwickelt. Die notwendigen Schritte des Konzepts werden beschrieben und exemplarisch durchgeführt.

Stichworte

Controlling, serviceorientierte Leistungsverrechnung, interne Leistungsverrechnung, Business Intelligence, Entscheidungsunterstützungssysteme, Kostenbewertung

Short teaser without bullet points [English]

This paper introduces a service-oriented cost allocation for business intelligence (BI). The current state in this field of research is presented and a comparison between the BI and IT domain is made. The main focus is on describing a developed model for a BI service-orientied cost allocation (BIsoCA). The major elements are the activity integration, the accounting net and the cost model. As a key result, BI services are defined, which are communicated over a BI service catalog to beneficiaries in a comprehensible way. The approach for implementing the BIsoCA is carried out using examples.

1 Introduction

In the information age it is becoming more and more important for companies to recognize the potential of internal and external data and to make use of it. To compete successfully on the market requires the information for the operative and strategic decision-making process to be provided at the right time and in a suitable form. In general this is realized by business intelligence (BI). BI is defined as an integrated, company-specific, IT-based global approach to operational decision support (Kemper et al. 2010). The principal purpose of BI is to use past experience to support the making of decisions (Fischer et al. 2008). In most enterprises, an internal department for BI, which in most cases is organized as a BI Competency Center (BICC)[1], provides this information (Dittmar et al. 2013) through a company-specific BI architecture and organization. Today the benefits of BI are undisputed and it has reached most enterprises.

With the ever increasing amounts of data being stored and analyzed by BI departments as costs for architecture and organization tend to increase. This is not only important in terms of consumer markets (e.g., social media) but also in industry. This development can be seen, for example, in the enhancements of ERP or CRM systems, or by new intelligently networked production processes which represent the fourth industrial revolution: industry 4.0 (Gebhard 2013). These new, or rather machine, data generate competitive advantages (Altmann 2013) for those companies that are able to analyze and use these data in a target-oriented way. The resulting increase in data creates new informational demands (Tomasura 2013) that must be met by a BI organization, for example. The ever-growing volume of information brings with it additional costs, and these costs must be charged fairly to those that bring them about. Due to rising costs as well as a more complex architecture (Seidler et al. 2012), in addition to new technology and methods, BI requires justification to management, especially during difficult economic times (Gibson et al. 2004, Lönnqvist and Pirttimäki 2006).

While it is already difficult in practice to quantify the total costs of a company's BI needs[2], there are at least frameworks to sum up the total costs for a BI technology landscape in a company (Fritzgerald 2000). However, it is an even harder problem to allocate those costs to the level of individual BI applications.[3] This arises because BI applications are complex due to their development process and interdependencies. The development process is company-specific and runs level-oriented both through a heterogeneous BI technology landscape and a BI organization structure (e.g. BICC or companywide distributed BI functions), making it difficult to assign used resources to a BI activity. Furthermore it is noted that companies have a low degree of maturity regarding BI (Dittmar et al. 2013). Another reason is the individual nature of a company's BI product portfolio. BI has to cover individual information needs, especially the continuously changing customer requirements. The last reason is that BI costs

---

[1] For further information regarding a BI competence center see http://www.gartner.com/id=400976 or Miller et al. (2006).

[2] According to a recent study by the market research organization Dynamic Markets, 72 percent of the companies surveyed are not able to identify their costs of reporting Frisch (2012).

[3] In this paper a BI application is understood as a well-defined company issue like "quality reporting" or "human resource reporting" that can be provided to one or many departments.

are mainly comprised of fixed costs, for instance, costs for personnel, hardware and software (Kargl and Kütz 2007).[4]

Due to the lack of cost transparency, four further problems arise: i. It is not possible to charge BI costs to beneficiaries in a fair way; ii. BI efforts cannot be considered reliably in project calculations (internal and external view); iii. Any outsourcing decision w.r.t. parts of the BI portfolio cannot be reasonable pursued; iv. From an organizational point of view it is difficult to locate potentials to improve the efficiency and productivity, and to plan the use of resources and justify it against the management.

i. In order to allocate costs in a fair way to the beneficiaries, the costs must be broken down such that it makes the individual BI activities visible and it determine costs at this level of BI creation. In most previous studies over the past decade regarding the evaluation of information systems, the cost perspective was regarded as resolved. However, this is certainly not the case. The degree of complexity stems from predominantly fixed and indirect costs which therefore make a cost allocation necessary, demonstrating that many unresolved issues still remain. So there are e.g. overhead allocation problems because of personal or political interests as well as identification problems in relation to how to handle usage-costs (Berghout and Remenyi 2005, van Maanen and Berghout 2002).

ii. The assessment of either a company's entire BI investments' or of individual BI applications' cost-effectiveness cannot be concluded (Pietsch 2003). In general, when e.g. BI is organized as a BICC it is perceived as an economically active dealing organization and, therefore, BI projects are approached without any reliable figures. Consequently, companies think it is worth the costs and do not carry out any accounting of BI costs (Popovic et al. 2010).[5]

iii. Furthermore, today's enormous cost pressure is leading companies to look for new outsourcing possibilities (Dittmar et al. 2013). The relevance of delivering BI as a service is becoming ever greater (Hagerty et al. 2012). However, to evaluate outsourcing decisions regarding individual BI applications, their internal costs must be known (or at least a reasonable estimate of them) (Kemper et al. 2007).

iv. With an improved cost transparency a BI department is able to locate cost savings and cost drivers. In addition with the ability to calculate BI applications incoming BI demands could be prioritized under consideration of their expected benefit (value). This will improve the efficiency (cost-benefit perspective) of the whole BI department as well as the use of BI resources for higher productivity.

It is the aim of this paper to increase BI cost transparency with an appropriate cost accounting system driven by a BI Controlling. A cost accounting system is used to control the process of BI creation and BI use within a company. It represents a managerial instrument which deliv-

[4] According to the IT Infrastructure Library (ITIL) the differentiation between direct and indirect (fixed) costs in BI is not applicable holistically. One exception would be external services, which can be assigned to a single BI-application Cannon et al. (2011).

[5] Usually a higher productivity or, respectively, a higher benefit is supposed.

ers information about value streams for planning, controlling and monitoring tasks on all hierarchical levels or is applied for decisions support (Coenenberg et al. 2009, Werner 2011).

But the specific nature of BI makes it difficult to realize a BI cost evaluation, which indeed must be distinguished from the traditional information technology (IT) perspective by its specific architecture and business domain. Furthermore it is important to ensure that the price of BI activities is calculated in a differentiated way, so that its implementation, operation, and any later reengineering are all taken into account.

It will then become possible to calculate both individual BI activities and entire BI projects so that the beneficiary can recover the costs. If they are charged with BI costs, beneficiaries within a company might also become sensitized to the economical use of BI. Moreover beneficiaries are supported in planning their personalized BI consumption to build an individualized BI shopping basket. In turn, this cost accounting system prevents the BI department from being considered as the sole cost driver (cost sink). Furthermore, an improvement in cost controlling could bring about a more efficient and effective use of BI resource project planning. Aside from the possibility of allowing make-or-buy decisions or cost benchmarks to be made, the improved cost transparency comes one step closer to performing a profitability analysis of planned or existing BI applications.

The paper is organized as follows. In Section 2 a comparison between the BI and IT domain is made. Afterwards requirements for the accounting of BI are defined. In Section 3 contributions will be discussed dealing with the accounting of artifacts generated by information technology (IT). In Section 4 a model for the internal BI cost allocation is developed which realizes the accounting as an overall approach. For evaluation purposes in Section 5 the developed model is analyzed by the defined requirements and improvements against the methods from Section 2. Section 6 summarizes the contributions and analyzes them critically and provides an outlook on further research needs.

2 Comparison of BI and IT

In Section 1 we motivated for a specific BI cost accounting approach. Due to this fact and the applicability of the following introduced methods for BI, this section makes a comparison between the BI and IT domain and describes requirements for a BI cost accounting system.

BI is understood as a subarea of IT and as such the overall cost structure of both BI and IT is similar. Both areas have basically fixed costs for hardware, software and personnel (Klesse 2008).

However, there are also substantial differences between IT and BI. One difference lies in the fact that e.g. all BI applications have a higher degree of interdependencies then it is common for IT applications as BI applications are typically based on a monolithic BI architecture. This leads to a huge pool of indirect costs for the BI software and hardware used. For example, while an IT service such as a PC workplace or a specific departmental software application often operates detached from one another consists more of direct costs then indirect costs. This, then, makes it easier to allocate the service to a beneficiary. How could one determine the costs for a single report (reports being different from a development point of view, as a

report's complexity and consumption of resources could increase by a single measure) or an analytic application (a cube for sales data) in a sensible way? Using a special BI cost accounting approach as detailed in this paper, this question could be answered.

Another area in which BI and IT differ is the business domain. While BI mainly provides information across organizational units within a company—and supports executives and management—IT concentrates on the company-wide availability of information technology for supporting the value-added process in the classic sense (Gansor et al. 2010). This means that BI must deal with various delivery systems and transform raw data into valuable data for supporting the decision-making process while keeping in mind the organizational-wide requirements of a much larger set of stakeholders than operational systems projects (Peco 2014).

This also leads to a differentiation between IT and BI requirements. BI is affected by complicated interdependencies regarding technical and functional requirements across many business functions as well as levels of management interests which lead to a higher level of complexity. In most cases, heterogeneous departmental objectives must be merged due to a lack of standardized managerial activities; this situation is different when it comes to transaction or operational systems hosted by IT departments (Kemper et al. 2008).

Another point of differentiation can be found in the architecture. For example, IT is characterized by the provision of hardware (PC workplace) and standard or individual software to support the execution of operational activities within a company. BI differs from IT by its integrated nature. Consequently, within the process of creating BI applications, a plethora of tools is generally used. Operational data must be extracted from heterogeneous data sources and transformed and historicized. This data also must be made recipient-oriented in order to provide decision-making support across a level-oriented BI architecture. Cost accounting, therefore, becomes more complex, as corresponding resources are shared. A higher complexity in the BI development process is expected, due to dependencies and close links that exist between parts of the operational systems. A uniform definition, then, is necessary for corporate data integration, including technical, as well as functional, aspects (Gluchowski et al. 2008).

In sum, BI applications, due to both their business domain, technical or functional requirements as well as underlying developmental and operational architecture, differ from classic IT applications and therefore must be treated differently (Kemper et al. 2008).

These differences lead to a different way of allocating or charging costs. Consequently, cost accounting approaches – even if applicable for IT cost allocation – need careful examination and adaptation before they can be applied to BI cost allocation. Therefore the essential requirements for a cost accounting system and internal cost allocation have to be examined too (Dobschütz 2000, Kargl and Kütz 2007). A comparison has to be made between the IT and BI perspectives since, on the one hand, these requirements differ in their understanding and realization and, on the other hand, the differentiation between the two may enable a new approach to be developed with regard to BI cost accounting:

- Fair allocation of IT/BI applications or activities: As compared to IT, BI has a shared infrastructure made up predominantly of fixed costs. Therefore, a fair allocation of BI

is realized by taking into consideration the complexity of a BI application created over the layered and (often) monolithic BI architecture (exact monitoring is expensive, so a new “more economical” approach is required).

- Transparent and comprehensible pricing: For acceptance reasons, a beneficiary should be able to understand how the price of a BI application or an activity has been derived. Due to the complexity of BI, providing an explanation for a price is a completely different activity than in the IT area. The price of a PC workplace or hosted software, for example, is calculated using the corresponding hardware or licensing costs. To calculate a price for a report, relevant costs within the BI architecture must be estimated. In this case, multiple components are shared by other BI applications.
- Understandable definitions of IT/BI activities for beneficiaries: A beneficiary should be able to understand which activities are included when e.g. buying a BI application. Activities obviously differ depending on the described areas (e.g., DWH development in BI and installation of a PC workplace in IT).
- Equal treatment of all beneficiaries: This requirement is especially difficult to realize in BI. For example, two apparently identical reports could be assigned the same fee. It would only take one different measure, however, to change the complexity of a report, thereby significantly increasing the use of resources. For equal treatment, then, a new fee would be required. The entire BI application portfolio is subject to this situation.
- Economically justifiable execution of service-oriented cost allocation: To satisfy this requirement in terms of the complex topic of BI, an approach needs to be realizable without an excessive amount of effort.
- Compatibility with the cost accounting system: Since IT/BI accounting costs fall under the controlling and cost accounting area, an approach should be compatible with this field. Furthermore, considering the constantly changing BI environment, a potential approach should have a degree of flexibility and not be based on technology.

3 State of the art

The existing literature provides no concrete approaches for solving the BI cost accounting issue in an overall context. However, in this section some useful work regarding subareas of BI and IT concepts are briefly described below. As the number of publications addressing BI cost accounting is limited, we extended our survey to include the IT perspective in an effort to present a variety of approaches and assess their applicability for BI purposes. We chose methods, concepts, and ideas from the academic literature as well from publications of IT/BI professionals or companies who deal with this topic and have pertinent approaches with which to improve BI cost accounting. As starting point the search engines “Google Scholar” and

"SpringerLink" as well as archives from "Business & Information Systems Engineering" and from "The Data Warehousing Institute (EU and US)" were searched.[6]

3.1 Managing costs and performance of information technology (Hamel et al. 2010)

This paper presents an overview of relevant scientific work regarding the topic of IT cost accounting over the period from 2000 to 2010. Although the focus of this work is on IT controlling, this paper was an anchor for our review, as it covers established IT controlling literature and provides a synthesis of relevant articles from information systems journals.

In their work, Hamel et al. define a common understanding of IT controlling. In a general sense, IT controlling is used to ensure an effective and efficient usage of underlying IT resources. More specifically, those objects generated by the relationship between information processing, controlling, and leadership are controlled in terms of effectiveness and efficiency. Furthermore, objectives such as functionality, quality, and adherence to deadlines are also taken into consideration. IT controlling coordinates the management of IT resources within an organization while keeping a defined IT strategy in mind. It attempts to achieve greater transparency about information management and the use of IT for decision-making support. Given the range of methods used to examine the value of existing and future IT assets, IT controlling provides a value-oriented management of IT resources.

3.2 ITIL – Financial management for IT services (Cannon et al. 2011)

This publication presents a collection of best practices for IT service management, and is otherwise known as the IT infrastructure library (ITIL). The financial management component for IT services is described as the process that manages the budgeting, accounting, and charging requirements of IT services. The goal is for an IT organization, which operates as a separate business unit, to carry out the accounting related to the costs they incur, and to create IT services for customers in an organization. The IT organization also aims to provide management with the opportunity to, for example, calculate business cases for proposed IT services. In addition to the topics of budgeting and pricing in this ITIL component, the focus of this section is on the accounting of IT services.

One basic element proposed by Cannon et al. is a cost model identifying expenditures and describing how costs relate to specific services and/or customers. This cost model is then used as a financial baseline from which to derive costs or pricing. A service provider, then, could define more than one cost model, depending on the organization and the individual objectives. One possible cost model is cost by IT organization which distinguishes between direct costs, such as salary, and indirect costs (shared costs), such as the network backbone as seen by IT. These costs are combined to arrive at the total cost of IT and are then simply allocated, for

---

[6] Key words which were used: business intelligence cost (and performance [or activity]) accounting, business intelligence cost allocation, business intelligence costing, business intelligence cost evaluation, business intelligence controlling. The same was made for the topic information technology instead of business intelligence.

example by the number of users to relevant business units. This model can be expanded to the cost by service model which calculates the total costs per service. Here direct and indirect costs are assigned to specific IT services. The allocation of indirect costs is described as being difficult and potentially requiring the use of measurement tools to ensure fair allocation. With regard to allocation, the following methods are mentioned and only briefly defined: Activity-based costing, utilization-based allocation, agreed basis for allocation, and indirect cost rate.

ITIL proposes a framework for designing IT service management processes. It also covers a variety of aspects regarding the financial management of IT services. Using the cost models outlined above, an allocation of IT services is provided. Due to their general nature, these approaches do not begin to explain how to carry out BI allocation. Using the requirements from Section 2, the above-mentioned approaches can help to determine how best to carry out an allocation from the IT perspective.

3.3 ITIL applied to BI

ITIL can also be applied to BI. Consulting firms have tried to adapt ITIL when considering particular BI requirements. Here general reference processes are proposed for the creation of BI applications. In addition, subjects for data delivery management, data quality management, as well as data structure management are considered (Grunewald 2013). Furthermore, some ITIL processes have been adapted to BI (Gansor et al. 2010), such as a process for metadata management. The question of how to charge BI costs, however, remains unanswered therefore we cannot provide a proper evaluation.

3.4 Internal cost allocation for IT (Bertleff 2001)

Bertleff motivates how strategic controlling can be supported by IT cost allocation. The main task of strategic controlling is to verify that the right things are done for the right customers. To support this issue in the IT context, a controller should know, for example, which activities give rise to which costs as well as which person is responsible. Furthermore, it must be determined whether the underlying IT department is working in an efficient and effective way. To increase the transparency of this situation, IT cost allocation should be introduced. The objectives of such cost allocation should be derived from the corporate strategy and must be clarified before implementation. Possible objectives could be an improvement of the transparency of IT costs, or allocation according to the cost-by-cause principle. We maintain the importance of keeping the customer as the center focus and creating customer-oriented IT products that are accountable in an understandable way. Bertleff points out that allocation over technical factors such as CPU usage or storage I/O cannot be used due to the difficulty of understanding and planning the resource consumption for customers. Therefore, a cost model is presented which distinguishes between an external, more product-oriented view for the customer, and an internal view representing single IT activities. Forming an IT product based on individual IT activities is described as complex and is not further specified. The idea is to allocate single IT activities to a customer (such as costs for hardware, software licenses, or LAN costs) by means of a defined IT product (such as a PC workplace). For planning issues

and better transparency, an IT product catalog, containing IT activities or pricing, for example, describes individual products.

This paper takes an IT product-oriented view. With regard to the requirements in Section 2, Bertleff's work is to improve the process of forming understandable definitions of IT services, such as the concrete example of a classic PC workplace. The other requirements are only briefly discussed and therefore remain undefined. It is our view that a BI cost allocation should take this approach into consideration and extend it to a BI-specific architecture.

3.5 Cost allocation for data warehouse competency centers (Klesse 2008)

This paper focuses on a method to carry out cost allocation for data warehouse competency centers (DWH CC). Products and services of the DWH CC, then, are modeled as so-called information products. These special types of products are based on an information product model that Klesse introduces in this paper. The cost model and accounting factors can be adjusted to fit the cost allocation's objectives. In addition, various pricing models are available to realize, for example, a cost-covering pricing. This method follows the principle of identifying all DWH activities, assigning them to information products as well as describing them both in terms of quality and quantity. Cost-performance weighting is carried out from a quantity and quality perspective. For a modeled information product, platform and process services must be assigned in detail. A platform service refers, for example, to storage capacity or CPU usage for a single entity. A process service refers, for example, to the development of an entity or of information. Klesse goes on to further describe how to use this concept to carry out cost accounting. Due to the fact that the resulting cost accounting system is based on the information product model, accounting can be carried out according to the costs-by-cause principle. With this user-oriented infrastructure accounting, an approach is presented for solving the IT infrastructure accounting problem.

Klesse's method provides an allocation of information products within a DWH CC. Therefore, it appears quite useful in realizing fairer allocation for this partial BI architecture component which is in shared use. By considering the resource consumption for every defined information product, derived costs would be charged to beneficiaries in an equal way. Because of the theoretical nature of this approach—it has not yet been tested in practice—it is not clear how helpful this method would be in coming closer to a holistic cost accounting for BI. Because of the detailed nature of this approach, we think it could be difficult to realize an economical, understandable, and maintainable cost allocation within a DWH CC. Aggravated by existing dependencies within the defined information product infrastructure, we suppose that the complexity of this approach would be enormous.

3.6 Cost accounting for shared IT Infrastructures (Brandl et al. 2007)

This paper introduces a method aimed at determining usage-based cost allocation keys for customer-oriented services based on their estimated resource consumption. The authors point out that an allocation of IT infrastructure costs to application owners would increase cost transparency. This can be achieved if every user request is tracked across systems by a unique user ID, resulting in a detailed monitoring and metering of the user's resource consumption.

Due to the considerable effort required to do this, it is not practical. To reduce the efforts involved in detailed monitoring, the user's IT resource consumption can be estimated using the following approach, which takes the three following requirements into consideration:

- The estimator should be unbiased.
- The estimate should be independent of the IT infrastructure.
- The estimate should create only limited extra work in terms of economic implementation.

The idea behind this task is to create so-called resource profiles which specify an invocation of a service. The allocation method is then described by invocations to a service within a given accounting period. Brandl et al. describe a service as being, for example, access to an information system such as “browse catalog” or “check plant status.” A service can also be defined as an application that contains these individual use cases. A resource profile is calculated by carrying out a certain number of load tests (10 to 100) under consideration of, for example, five different user roles (low to heavy user). Hence it is possible to derive an average CPU time, storage I/O and network traffic for a single service.

The resulting resource profiles measure the average behavior of different user types for a given IT service. The resource consumption measurement is therefore made on a more abstract level to handle the problem of an expensive hard monitoring of every service invocation. Hence these resource profiles could be useful as cost allocation keys for cost allocation in shared IT infrastructures. In terms of the requirements in Section 2, his approach comes closer to a fair allocation of BI costs, but it is not certain that all beneficiaries are treated equally. A user could make extra use of a service such as a dynamic BI report by applying filter settings in such a way that a defined resource profile is no longer applicable. Depending on a company's current situation, BI applications might be needed more in economically difficult times than in prosperous times. Therefore, it is necessary to continuously recalculate resource profiles. This, in turn, leads to increased expenses, making the resulting IT or BI cost allocation economically unfeasible. In addition, BI application consumption is difficult to forecast, because the demand for decisions is not subject to regularity in normal cases.

3.7 From strategy to business intelligence competency center (Gansor et al. 2010)

The authors of this publication describe the development and operation of a BI competency center (BICC) by considering a wide range of topics: from the creation of a BI strategy to the definition and arrangement to the operation of a BICC. The controlling of a BICC is presented under the topic of operation. One essential point must be made clearly evident for beneficiaries: exactly which BI services are provided, whether once or on a regular basis, at what level of quality, and at what cost. Service level agreements are mentioned as prior conditions for the charging of costs and for cost-oriented management. Furthermore, BI services must be specified in a catalog. The authors thus emphasize the significant difference between IT and BI: While BI focuses on delivering information for the decision-making process across business functions at a more managerial level, the IT department provides information technology to support operational processes. Because of the multi-level BI process for information gener-

ation and an intra-divisional use, it is difficult to determine the cost of a specific piece of information. A method by Klesse (Section 3.5) is briefly described as a possible approach, with the realization of an internal cost allocation described as a difficult task. Gansor et al. describe three approaches to realize an internal cost allocation carried out in a BICC that is organized as a cost center:

- A) Flat rate distribution keys: Since a BICC acts across departments within a company, the allocation of BI costs could be realized by charging overhead costs. It remains unclear how to best derive a suitable distribution key. This flat rate approach is criticized because of the possibility of billing only low costs to very active customers. Furthermore, because of missing assessments for individual BI services, an external comparison is not given. In addition, it is mentioned that a flat rate allocation does not contribute to beneficiaries' cost awareness. Ad-hoc reports, then, which may be relatively easy for beneficiaries to create, are transferred to the BICC which cause additional expenses.
- B) Usage-dependent allocation: This approach proposes to charge individual requested services in a BICC in detail. Intensive users are thereby charged more than occasional users. As a basis for allocation, the time spent creating a BI service or resource-dependent metrics such as storage volume or quantity of reports could be used. The main challenge of this approach lies in the automated charging of the determined measurements. Furthermore, there is a conflict of objective, as a cost center manager could be encouraged to reduce costs relating to the optimization of premiums and therefore individual BI demands might not be implemented by a BICC but through an island solution.
- C) BI project portfolio: The last BI cost allocation approach involves the expected usage and is realized by considering the BI project portfolio. This requires departments that plan a project to pay the resulting costs of the BICC. The above-mentioned conflict of objective could therefore be resolved by including the planned charging of BI costs within the department's targeted cost planning.

As mentioned above the first approach doesn't realize a fair allocation of BI costs and is therefore not suited to solve the overall problem in this paper. By considering the BI project portfolio to allocate BI costs the question of how to calculate costs for a BI project and later operations costs still remains open. Just as Gansor et al. mention, the aim has to be to charge BI services by a usage-dependent allocation. But the authors are not elaborating how to do it in a practical way.

3.8 Assessment

The approaches screened in this paper are intended to provide an overview of appropriate approaches to the allocation of BI costs. A comparison between the BI and IT domain has shown that these two areas differ significantly and therefore require different costing approaches. It is worth noting that none of the approaches introduced here refers to BI accounting in a holistic way. The methods presented here are on a very high level of abstraction so that it is difficult to evaluate their practicability.

There are, however, general and detailed accounting ideas which may be adaptable to individual components of BI architecture. The approaches presented by Klesse (Klesse 2008) or Brandl (Brandl et al. 2007) attempt to solve aspects of the entire problematic situation, but because of their meticulous methods, we assume this would bring about very high expenses in practice. Klesse focuses on information product accounting within a DWH CC, whereas Brandl provides a method for distinguishing allocation keys by so-called resource profiles. The direct implementation of both methods as BI cost allocation methods, which could indeed lead to a fair allocation of BI costs, would result in an uneconomical overall BI cost accounting system. Standard publications regarding IT controlling, such as ITIL (Cannon et al. 2011) or Hamel et al. (Hamel et al. 2010), provide an overview of IT controlling, but the description of individual concepts remains very general. We further concentrate on a usage-dependent allocation of BI costs like Gansor et al. which has to be practicable. In summary, many questions remain with regard to BI cost accounting. Like how to derive a BI service portfolio and the underlying cost model to generate prices for single services. To add to this, there are still issues concerning IT controlling, particularly the allocation of IT costs, that remain unresolved (Berghout and Remenyi 2005).

4 Service-oriented cost allocation for Business Intelligence

This paper contributes to the improvement or realization of the cost transparency for an inhouse BI department. We propose structuring a company's BI cost pool in a way such that single (planned or existing) BI applications become calculable on the basis of cost. More precise costing allows for better company internal invoicing to the beneficiaries of the BI artifacts. In turn, this cost allocation system prevents the BI department from being considered as the sole cost driver (cost sink). Through defining BI services customer understanding increases and beneficiaries are sensitized to using BI in an economic way.

To achieve this goal, we propose the following BI output hierarchy. As previously mentioned, a result of this paper is the specification of BI services, which are product-oriented artifacts from the beneficiary point of view. A BI artifact is any output of a BI organization such as a report, consulting, or server maintenance. A BI service consists of single BI activities, such as *data processing* or *quality assurance*. With a bunch of BI services, a single BI application could be specified and calculated. Beyond that, it would be possible to value a BI project consisting of one or more BI applications. So it is, for example, possible to value the project portfolio within a BI department. Figure 1 shows these dependencies as a BI output hierarchy.

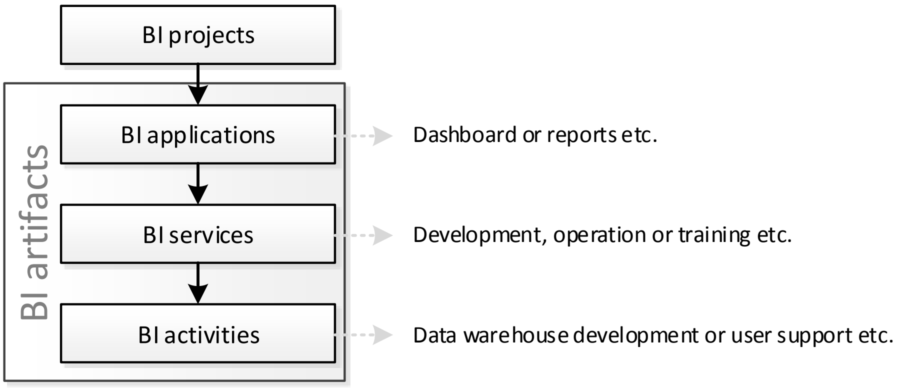

Figure 1: BI output hierarchy

To realize the quantification of single BI applications we propose an internal cost allocation under consideration of the BI specific characteristics as well as the requirements from Section 2. In the sense of a shared service center, which is a common form of organization for BI, and customer orientation in the following we use the term Business Intelligence service-oriented Cost Allocation (BIsoCA). The BIsoCA consists of the components activity integration, accounting net, cost model and service catalog, which describes the defined BI services. This approach realizes a simplified usage-dependent allocation based on (Gansor et al. 2010) (B) and is based on the general model by (Klesse 2008). The process model is illustrated in Figure 2.

Single BI activities are bunched over several steps to form services, which are the major elements of allocation and communication to the internal or external beneficiary. The accounting net defines the method of price determination. The objective is to achieve simultaneously a sufficient fair allocation of the occurred costs and a practical feasibility of the model. Within the cost model on the one hand cost transparency is realized by a made total cost investigation and on the other hand the defined calculation method determines transfer prices for single services. Alongside it is thinkable to intervene by using political transfer prices.

The BI service catalog is understood as a platform for using and communicating services. This catalog offers a description, transfer prices and presents included activities. Also it is possible to specify services by using service level agreements. This will allow customers to build an individualized BI shopping basket. By setting up targets and requirements for the process model based on the BI strategy, a strategic alignment towards the business model as well as the corporate strategy is considered.

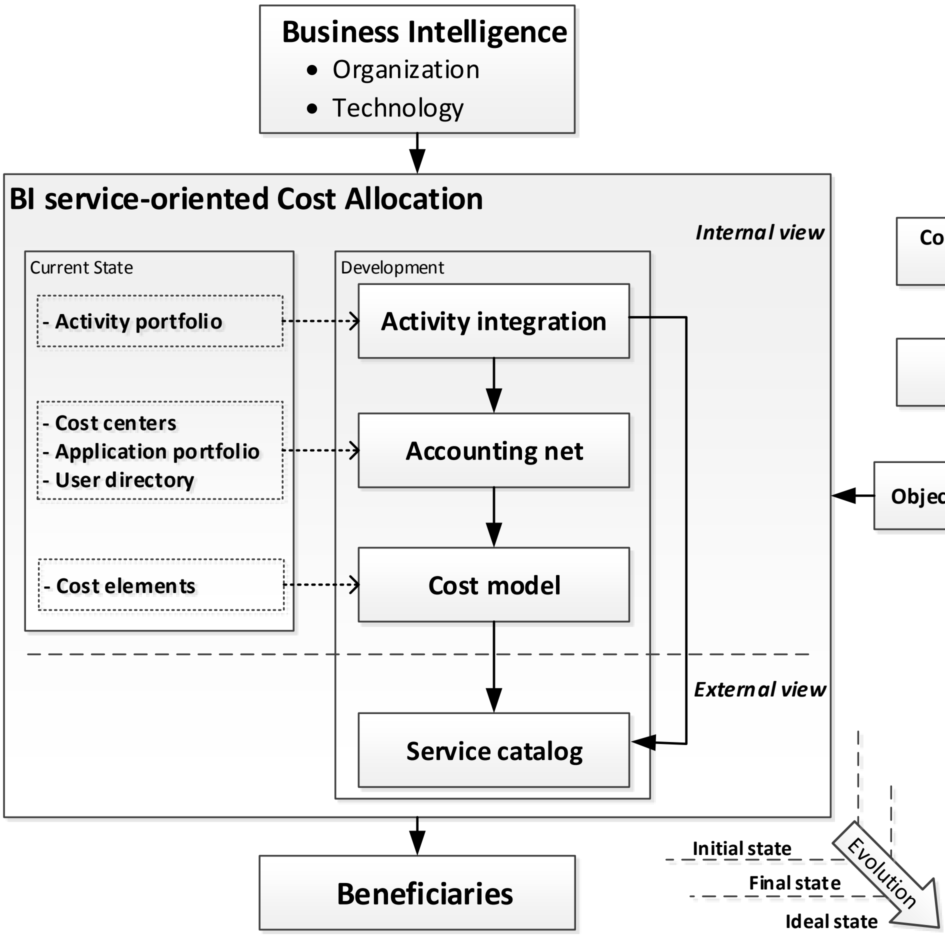

Figure 2: Process model of the BIsoCA

The next few sections describe the elements of the presented model in detail.

4.1 Activity integration

In companies, the BI department has to provide necessary resources in the form of a BI organization and BI technology to generate BI activities. Generally e.g. two reports are not per se comparable, although they are identical in appearance. Report's complexity could increase extremely by a single measure. Therefore it is necessary to structure all activities in categories to allow a differentiated evaluation of e.g. reports. Derived services in this part of the process model then could have a fixed price or depending on the individual effort of an application could be calculated dynamical respectively more exact and fair. For instance costs of operation are allocated over a fixed charge, whereas development activities are considered by variable costs in the form of provided effort of time. This approach encourages, that planed BI applications become assessable and it becomes possible to pre-estimate an applications' price before realization.

The basic idea of the activity integration is to determine, which activities are perceived as an integrated product respectively service. Hence these activities have to be grouped so to offer and later allocate this defined services to beneficiaries. Attention must be paid by describing single activities plus their aggregation to services in an understandable way. As a relevant input variable for the activity integration the activity portfolio has to be documented. It summarizes all in-company activities, which are created by a BI department. On the one hand

these are activities, which are utilized collaboratively from multiple departments, e.g. the monitoring of ETL processes or the operation of cubes. On the other hand there are activities which could be assigned directly to a beneficiary, like supporting and supervising projects, development or training.

The activity integration is now pursuing the aim of grouping activities to define a structure for deriving BI services. These services represent cost objects of or our model. By using structured methods, e.g. card sorting (Tullis and Albert 2008) it's initially possible to find coarse categories, which can be refined in the further course. The level of detail has to be chosen company specific. As an example structure we propose a categorization by operation, development, consulting as well as training. Figure 3 shows an example for the activity integration. Within the *Operations* part, all BI applications as well as all BI users and, respectively, beneficiaries are supported. At this point a second stage of activity integration takes place. All activities with a direct connection to the *Operation of applications* and *User support* are summarized again. The application portfolio in Table 2 (Appendix) shows explicitly that costs for the operations of reporting, analytic and planning applications have to be considered. Therefore, single BI services for these three different types of application are created. Aside from the applications, this necessitates service charges for different user roles, as specified in the category *User support* (not described in detail). For instance, access to the reporting system is considered by *Supporting reporting user* or analysis activities are taken into account by *Supporting analytic user*. Beside the operating activities, a service for BI *Development* is described. Additional services for BI *Consulting* and BI *Training* are not performed in this paper.

To meet the requirement of an economically justifiable execution (Section 2) for the BIsoCA it is not possible to cover every information need and to charge it to the corresponding beneficiary. Therefore, efforts requiring more than eight hours of, for example, development or consulting, are charged separately. Consequently, the development of a "simple" report is covered by charging the operation service *Reporting application* to a beneficiary, whereas a "complex" report is additionally calculated through the *Development* service. Because services for consulting and training can be assigned directly to a beneficiary, these services are also specified separately.

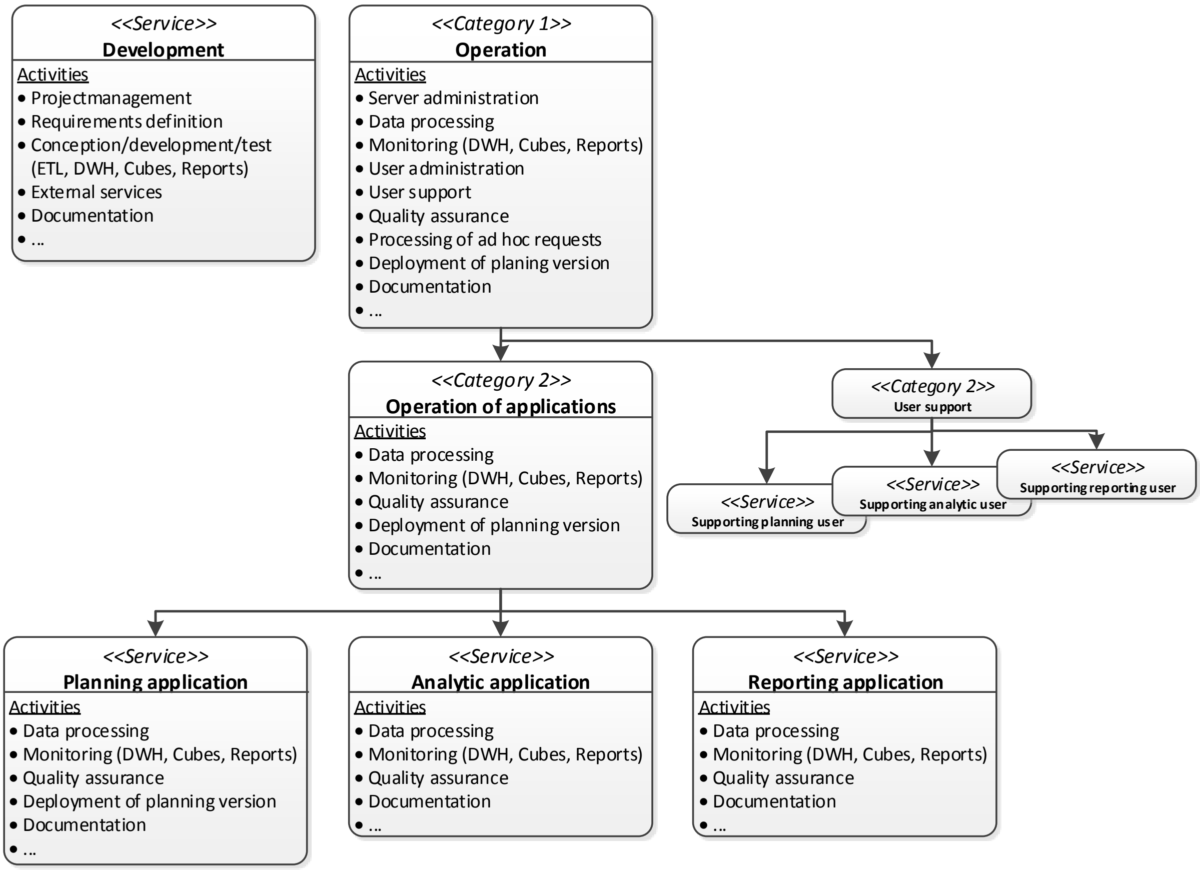

Figure 3: Activity Integration

4.2 Accounting net and cost model

The accounting net extends the activity integration with allocation methods and represents the connector between BI department and beneficiaries. It represents the BIsoCA as cost accounting system. The determination of primary and secondary cost centers creates a base to build up the accounting net. In this step BI costs that are not accounted to the BI cost centers should be detected and corrected. The cost view is then expanded to a more detailed cost documentation which is performed by the total cost of ownership (TCO).[7] The objective here is to localize all direct and indirect costs that are created by the BI department. Thus, on the one hand cost drivers will be identified, while on the other hand complete cost transparency will be created.

The accounting net documents, how transfer prices are determined for defined services. In addition allocation bases as well as required distribution keys are provided. Because most of the monthly occurred costs in a BI department are fixed costs, it gives rise to the question of how these costs should be assigned to the services. To meet the requirement of an economical justifiable BIsoCA, we suggest using a distribution by time recording. This implies an obligatory time recording for the BI organization.[8] Therefore it is possible to document the time

[7] The TCO tries to localize all arising direct costs, e.g., costs of acquisition and operation as well as indirect costs, e.g., cost of system failure Gansor et al. (2010).

[8] The time recording has to be discussed with affected employees as well as with the worker's council (cf. § 87 para. 1 No. 6 BetrVG Germany).

required per activity and thus to measure the total effort e.g. for the category *Operation.* Continuous time recording allows for a more realistic distribution key by average values over a year and as the case may be seasonal and calendar effects could by adjusted. The same could be done for the category *User support* as efforts for supporting the particular user roles are recorded too. Because BI applications are complex and have different resource consumptions in operations, it is not easy to derive a distribution key. One could try to measure precisely the load caused by any single component of a BI system. However, in most environments, this is either impossible or very costly and cumbersome. Instead, we recommend an approximation of the operation costs using a method based on a more abstract level. Here it is necessary to value the complexity for every BI application in the application portfolio over the e.g. three-tier architecture (data warehouse, cube-layer, frontend). By summarizing the single evaluations per application a distribution key for the different application types (reporting, planning, analytic) is developed.

The cost model enhances the accounting net by the cost view. Thus, on the one hand cost drivers will be identified, while on the other hand complete cost transparency will be created.

First, however, we should verify which organizational status to assign to the BI department and whether the costs are allocated by actual or planned costs on a partial or full cost basis. In the classical sense a BI department is considered in the company's budgeting process and therefore has to present its success through cost recovery and is a non-profit organization. Therefore we exclude a profit center as an organizational form. Based on these facts we propose an organizational orientation as service center for the here mentioned examples.[9] The main activity of the BI department is to obtain BI resources from the external or internal market, process the subsequent service creation and provide the outgoing services to beneficiaries.[10] We can then exclude the use of partial costs because in this case only the variable part of the BI costs is charged. As a result, the BI department would generate a loss arising from the fixed costs (Friedl et al. 2010). Therefore this valuation rate is not appropriate for an organization run as a service center (Coenenberg et al. 2009). The use of full costs ensures that in the long term all costs are covered (Coenenberg et al. 2009). Furthermore, planned costs should be used because using actual costs makes fixed cost degressions appear. For instance, just one requested report would be considerably more expensive than ten requested reports. Moreover, at the end of a period, variance analysis should be possible by comparing the planned with the actual costs. Here the BI department is responsible for deviations between actual and planned transfer prices (Friedl et al. 2010). Hence, the use of planned costs on a full cost basis is justified.

In order to determine the transfer prices of the BI services, the accounting net and the cost documentation e.g. cost centers are combined. The total monthly BI costs are thus distributed to BI services. Before single transfer prices are generated, the whole output to all beneficiaries has to be determined per BI service. The output in *Operation of applications* is determined as

---

[9] Cf. Kargl and Kütz (2007) for the difference between cost, service and cost center.

[10] Horváth (2011) and Gansor et al. (2010) only distinguish between cost and profit center. Although according to their definitions, a classification as cost center is legitimized. The terms cost center and service center are used synonymously. However, in this paper the service concept remains in the foreground, and thus the BI department is described as service center.

the sum of all current reports, analytic and planning applications. The quantity of all users in *User support* is identified as the authorization component (user directory) of the used BI system. Because BI *Development*, *Consulting* and *Training* allow an allocation of costs in a fair way, the transfer prices are calculated on an hourly basis. Here the monthly available total capacity of the personnel resource within the BI department has to be considered. An example for calculating die costs for development and the cost of operation for a report are shown in Figure 4.

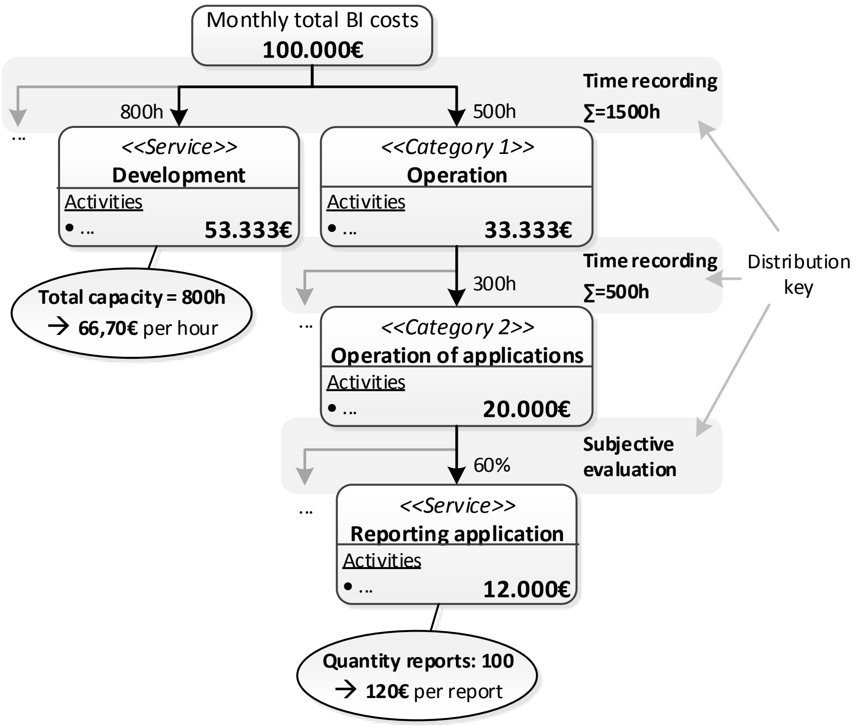

Figure 4: Transfer prices for development and operation of a report

4.3 BI service catalog

The BI service catalog is a summary of all BI services, presented in a clear arrangement. This catalog could be interpreted within the company as a marketing tool, which simultaneously communicates the value of the BI department to beneficiaries (Gansor et al. 2010). Through the BI service catalog, beneficiaries are informed about the transfer prices of single BI services, and their composition of activities (Bertleff 2001). This paper excludes a comprehensive definition of the BI service catalog for the BI service portfolio. At this point we refer to (Krcmar 2010) for a detailed approach for designing an IT service catalog. The essential foundations for building a BI service catalog are the cost model and the activity integration. Figure 5 shows an example for a description of the BI service *Operation BI reporting application.*

Description: Reporting application

Activities included: - Data processing
- Monitoring (DWH, Cubes, Reports)
- Quality assurance
- Documentation
- ...

Accounting unit: Report per unit

Transfer price per unit: 120€/month

Preconditions: - Access to BI system via *User Support – Supporting reporting user*
- Base training for reporting

Conditions: Minimum duration is 6 months

Service level agreements: - Availability: Monday to Friday (24 h)
- Response time: < 2 minutes

Figure 5: Service for *Reporting application*

In addition, it is conceivable that service level agreements (SLA) can be specified. An SLA describes an agreement relating to the delivery of an activity with an agreed timeframe and quality, with preassigned costs (Horváth 2011, Kütz 2011). Hence it is possible to describe the quality of BI services to beneficiaries. One typical and important SLA for BI applications is the response time. If the response time is not achieved, effective measures have to be defined and implemented. For example, the BI department would have to correct reports or reduce the transfer prices (Kütz 2011).

With a more comprehensible presentation of BI services via the BI service catalog, beneficiaries are supported in planning their personalized BI consumption to build an individualized BI shopping basket. This takes above all the requirements in Section 2 into consideration.

5 Concept evaluation

Moving forward to an in depth evaluation of the approaches presented in the related work in Section 3 and our approach in Section 4, we begin with stating the evaluation criteria. The criteria is derived by considering the requirements for a cost accounting system in Section 2. To achieve a more differentiated view we divide the criteria into a theoretical and practical view. The criteria definition was discussed with BI professionals from industry.

For an evaluation of the methods we rate the criteria on a scale from 1 (not fulfilled) to 5 (fulfilled). The result is shown in Table 1. Because Hamel et al. in Section 3.1 summarizes the literature for IT cost accounting in a general form, this contribution is not evaluated. Section 3.3 is also a general description and therefore not assessable. While the approach by Klesse in Section 3.5 is very exact we only give three points for exactness because here only the DWH perspective is considered and the extension to BI is non-trivial. The same was considered by Brandl et al. in Section 3.7 because here a method to derive distribution keys for e.g. a cost accounting system is focused.

	3.2 Cannon et al. 2011	3.4 Bertleff 2001	3.5 Klesse 2008	3.6 Brandl et al. 2007	3.7 Gansor et al. 2010			4 BIsoCA
					A	**B**	**C**	
Theoretical view								
Feasibility for BI	3	3	1	1	5	1	3	4
Exactness	2	3	3	3	1	5	2	4
Evolution (Agility)	3	3	1	1	4	1	3	4
Compatibility (cost accounting system)	4	4	1	2	5	2	2	4
Adaptability for BI	1	1	4	3	5	3	3	5
∑	13	14	10	10	20	12	13	21
Practical view								
Increase of Transparency	3	3	3	3	1	4	2	4
Understandability	4	4	1	2	4	2	3	4
Neutrality of treatment	1	1	4	2	1	5	3	4
Economical use	4	3	1	1	4	1	3	3
∑	12	11	9	8	10	12	11	15
∑	**25**	**25**	**19**	**18**	**30**	**24**	**24**	**36**

Table 1: Result of the evaluation

In summary it can be stated that the methods by Klesse (19 points) and Brandl et al. (18 points) have an insufficient achievement of the assessment criteria. The middle field is characterized by methods with 24 to 25 points which score very well on some criteria but still mostly have bad results and therefore remain unimpressive. Surprisingly the flat rate allocation of overhead costs by Gansor et al. in Section 3.7 (A) reaches 30 points and is the second-best approach. On the one hand this was achieved by simplicity but on the other hand im-

portant criteria for an overall approach like exactness, increase of transparency and neutrality of treatment are only valuated with one point. The BIsoCA introduced in this paper is assessed with 36 points as the best method. The BIsoCA cannot fulfill all criteria with the highest rate, but it correct the weakness of the other presented methods in this paper and therefore we estimate this method as more appropriate.

6 Conclusion and outlook

The main challenge in this paper was to propose a design that rendered the BI cost pool accountable and improved cost transparency. In consequence of a heterogeneous system landscape and a technical as well as functional complexity which for the most part is multi layered, there are applications and planned projects where the price to derive is difficult. The BIsoCA realizes a practicable approach to determine the total BI costs. These costs become calculable by a defined company-specific allocation structure and understandable services with transfer prices. By differentiating activities in fixed and variable costs the cost allocation becomes more appropriate.

A fair allocation of BI activities is enabled by the sequent construction of the cost model. It is impossible to accomplish this requirement in full. One reason is that in practice it becomes uneconomical for the BIsoCA to charge every requested information need. Furthermore the operation of this approach causes additional costs e.g. for time recording. These costs have to be considered and therefore the BIsoCA has to be implemented company specific (in an iterative way by increasing accuracy). Beyond that, an allocation based on measuring the load of single BI system components is too complex and expensive. Therefore, to approximate a fair allocation and equal treatment of all beneficiaries, the operating costs for the defined BI application types in the cost model are charged with a fee through a BI service. This pragmatism leads to a transparent and comprehensible understanding from the beneficiary point of view and makes its implementation economically justifiable. However, when considering the individual part of an information need, especially development or consulting costs, these costs are calculated on an hourly basis through the defined BI services in a fairer way.

With the developed BI service catalog, the service portfolio is communicated within a company. This increases understanding of the BI department's activities, in particular the requirements for realizing a BI application. Single BI services with corresponding transfer prices are described in an understandable way to beneficiaries. In this way they can create an individual BI shopping basket as well as plan their information consumption. With increased transparency and conformability for the beneficiary, the BI department will also be supported in respect to BI resource planning issues through beneficiary demands. Efforts for larger BI projects must be determined by the BI department and must be considered in the BI project plan.

Through the ideas presented we achieve an increase in cost transparency in a BI department, and can sensitize beneficiaries to use BI resources economically. So cost savings can be achieved by only realizing the information demands which matter. And we assume that the quality of requirements definition will increase and therefore shorter development cycles will be possible. At this point it should be noted that an introduced pricing could result in an anticipated higher qualitative output. In addition, it facilitates the projection of the degree of BI resource utilization. Further topics such as benchmarking are improved because, for example,

hourly rates for development or the cost documentation become comparable with data for BI benchmarks. The BI service portfolio enables the calculation of BI projects. Subsequently, demands can be calculated prior to development and analyzed from the point of view of cost, for example, for making or buying purposes. Beyond that, single BI requirements are valuable in comparison to the perceived benefit, so that it is possible to put incoming BI requirements into an economically meaningful order.

The future aim is to implement the design concept of the BIsoCA, to analyze its function in practice under real conditions. In this connection, as well as the technical execution, the change in user behavior and, respectively, the general mood in a company have to be analyzed. The evolutional nature of the designed controlling instrument makes it possible to adapt the cost model, so that a future refinement with further BI services is conceivable and, therefore, a more precise form of accounting can be designed.

This work provides a new conceptual approach to achieving a more exact cost evaluation of BI in step with actual practice and, therefore, offers improved understanding in the evaluation of the economic efficiency of, for example, BI applications. Therefore, we expect the introduction of our concept to result in an improvement in the overall situation in an in-house BI department.

7 Appendix

Category	Beneficiary	Application
Reporting	Sales and distribution/ controlling	Monthly values
		Daily values
		Budget values
		Sales forecast
		Incoming orders
		Orders on hand and backorders
	Sales and distribution	Market data
	Supply chain management	Purchasing
		Inventory
		Measurement of delivery service
		Quality
	Human resources	Human resources reporting
	Managing board	Dashboard
Analysis	Sales and distribution	Market basket analysis
	Controlling	Cost analysis
Planning/forecast	Contrtolling/ Managing board	Target setting
		Forecasting
		Budgeting

Table 2: Application portfolio

References

Altmann G (2013) Industry 4.0 Monitor. Auswertung von Maschinendaten. http://www.sas.de/forsastudie-maschinendaten. Accessed 18 Sep 2013

Berghout E, Remenyi D (2005) The Eleven Years of the European Conference on IT Evaluation: Retrospectives and Perspectives for Possible Future Research. Electronic Journal of Information Systems Evaluation 8(2):81–98

Bertleff C (2001) Einführung einer IT-Leistungsverrechnung zur Unterstützung des strategischen IT-Controllings. HMD - Praxis der Wirtschaftsinformatik(217):57–66

Brandl R, Bichler M, Strobel M (2007) Cost accounting for shared IT infrastructures. Wirtschaftsinformatik 49(2):83–94

Cannon D, Wheeldon D, Lacy S, Hanna A (2011) ITIL service strategy, 2nd ed., 2011 ed. TSO, London

Coenenberg AG, Fischer TM, Günther T (2009) Kostenrechnung und Kostenanalyse, 7th edn. Schäffer-Poeschel, Stuttgart

Dittmar C, Oßendoth V, Schulze K (2013) Business Intelligence: Status quo in Europa. Europäische biMA®-Studie 2012/13. http://www.steria.com/de/bi/bidm-einblicke/europaeische-bima-studie-201213/. Accessed 31 Aug 2013

Dobschütz L von (2000) IV-Controlling. Konzepte - Umsetzungen - Erfahrungen. Gabler, Wiesbaden

Fischer J, Dangelmaier W, Nastansky L, Suhl L (2008) Bausteine der Wirtschaftsinformatik. Grundlagen und Anwendungen, 4th edn. ESV basics. Erich Schmidt, Berlin

Friedl G, Hofmann C, Pedell B (2010) Kostenrechnung, 1st edn. Vahlen, Franz, München

Frisch J (2012) Effizientes Finanzreporting erhöht das Vertrauen und senkt Kosten. isreport(7+8/2012):10–12

Fritzgerald M (2000) Calculating the ROI for Business Intelligence Projects. http://www.information-management.com/news/2487-1.html. Accessed 07 Sep 2013

Gansor T, Totok A, Stock S (2010) Von der Strategie zum Business Intelligence Competency Center (BICC). Konzeption - Betrieb - Praxis. Hanser, München

Gebhard E (2013) Industrie 4.0 – sind die Netze fit für die vierte industrielle Revolution? http://www.silicon.de/41582787/industrie-4-0-sind-die-netze-fit-fur-die-vierte-industrielle-revolution/. Accessed 18 Sep 2013

Gibson M, Arnott D, Jagielska I (2004) Evaluating the Intangible Benefits of Business Intelligence: Review & Research Agenda. Decision Support in an Uncertain and Complex World: The IFIP TC8/WG8.3 International Conference 2004:295–305

Gluchowski P, Gabriel R, Dittmar C (2008) Management-Support-Systeme und Business Intelligence. Computergestützte Informationssysteme für Fach- und Führungskräfte, 2nd edn. Springer, Berlin, Heidelberg

Grunewald V (2013) BI-Service-Management biTIL® / Sourcing Beratung. http://www.steria.com/de/bi/bidm-loesungen/governance/betreibermodelle/. Accessed 09 Sep 2013

Hagerty J, Sallam RL, Richardson J (2012) Magic quadrant for business intelligence platforms. http://www.gartner.com/id=1915014. Accessed 19 Sep 2013

Hamel F, Herz TP, Uebernickel F, Brenner W (2010) State of the art: Managing costs and performance of Information Technology. AMCIS 2010 Proceedings(Paper 516)

Horváth P (2011) Controlling. Vahlen

Kargl H, Kütz M (2007) IV-Controlling, 5th edn. Oldenbourg, München u. a.

Kemper H, Baars H, Horakh TA (2007) Business Intelligence Outsourcing - A Framework. In: Österle H, Schelp J, Winter R (eds) Proceedings of the Fifteenth European Conference on Information Systems, ECIS 2007, St. Gallen, Switzerland, 2007. University of St. Gallen, pp 1155–1166

Kemper H, Baars H, Horakh TA (2008) Business Intelligence (BI). Service-Orientierung in der IT-basierten Managementunterstützung. Controlling & Management : ZfCM ; Zeitschrift für Controlling & Management(2):100–108

Kemper H, Mehanna W, Baars H (2010) Business Intelligence - Grundlagen und praktische Anwendungen. Eine Einführung in die IT-basierte Managementunterstützung ; [mit Online-Service]. Business Intelligence - Grundlagen und praktische Anwendungen

Klesse M (2008) Methode zur Gestaltung einer Leistungsverrechnung für DWH Competence Center. In: Töpfer J, Winter R (eds) Active Enterprise Intelligence™. Springer Berlin Heidelberg, pp 243–272

Krcmar H (2010) Informationsmanagement, 5., vollst. überarb. und erw. Aufl. Springer, Berlin

Kütz M (2011) Kennzahlen in der IT. Dpunkt-Verl

Lönnqvist A, Pirttimäki V (2006) The Measurement of Business Intelligence. Information Systems Management 23(1):32–40. doi: 10.1201/1078.10580530/45769.23.1.20061201/91770.4

Miller GJ, Bräutigam D, Gerlach SV (2006) Business intelligence competency centers. A team approach to maximizing competitive advantage. John Wiley & Sons, Hoboken, N.J

Peco M (2014) TDWI world conference Las Vegas 2014. TDWI Project Management for Business Intelligence. February 23-28. The Data Warehousing Institute, Renton

Pietsch T (2003) Bewertung von Informations- und Kommunikationssystemen. Ein Vergleich betriebswirtschaftlicher Verfahren, 2nd edn. Erich Schmidt, Berlin

Popovic A, Turk T, Jaklic J (2010) Conceptual Model of Business Value of Business Intelligence Systems. Management 15(1):5–30

Seidler L, Mack M, Bange C (2012) Business Intelligence im Mittelstand 2011/2012. Status quo, Ausblick und Empfehlungen - 2. Auflage. http://www.barc.de/category/domains-themes/business-intelligence/marktforschung-business-intelligence-im-mittelstand-20112012. Accessed 31 Aug 2013

Tomasura MA (2013) Big Data Changed the Way We Think About Data Warehousing. http://www.information-management.com/news/big-data-changed-the-way-we-think-about-data-warehousing-10024849-1.html. Accessed 14 Sep 2013

Tullis T, Albert B (2008) Measuring the user experience. Collecting, analyzing, and presenting usability metrics. The Morgan Kaufmann series in interactive technologies. Elsevier/Morgan Kaufmann, Amsterdam

van Maanen H, Berghout E (2002) Cost management of IT beyond cost of ownership models: a state of the art overview of the Dutch financial services industry. Evaluation and Program Planning 25(2):167–173. doi: 10.1016/S0149-7189(02)00010-1

Werner T (2011) Grundlagen der Kosten- und Leistungsrechnung mit Aufgaben und Lösungen. Salzwasser Verlag, Paderborn